

The **MIDI Manual**



- ▶ *Learn how to put MIDI to work for you*
- ▶ *Details on latest MIDI equipment*
- ▶ *Strategies for professional MIDI performance*

The MIDI Manual

Music is the universal language, and computers have become tools of the universe. Now you can incorporate both easily with *The MIDI Manual*. Audio enthusiasts, musicians, and professionals alike will find all the answers in this comprehensive text!

Written as an all-around guide to this intensely popular technology, the book provides a close-up look at the industry's top products. You learn how to integrate them with the IBM® PC, Macintosh®, and Atari®. Illustrations and step-by-step lessons teach you how to set up an efficient MIDI system. Plus, you learn to use your computer to expand your musical recording techniques—and your performance.

The MIDI Manual helps you master the mysteries. Inside, you'll learn:

- ▶ MIDI components, functions, and fundamentals
- ▶ MIDI's full range of production techniques
- ▶ The science of synchronization
- ▶ How to combine MIDI and sync pulse timing
- ▶ The art of sequencing

In a very short time, you can orchestrate a chamber ensemble while playing the drums—all with computer memory, a few cables, and *The MIDI Manual*!



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Introduction

Simply stated, *Musical Instrument Digital Interface (MIDI)* is a digital communications language and compatible hardware specification that allows multiple electronic instruments, performance controllers, computers, and other related devices to communicate with each other within a connected network (Fig. 1-1). It is used to translate performance- or control-related events (such as the actions of playing a keyboard, selecting a patch number, varying a modulation wheel, etc.) into equivalent digital messages and to transmit these messages to other MIDI devices where they can be used to control the sound generation and parameters of such devices within a performance setting. In addition, MIDI data can be recorded into a digital device (known as a *sequencer*), which can be used to record, edit, and output MIDI performance data.

In artistic terms, this digital language is a new and emerging medium that enables artists to express themselves with a degree of expression and control that was, until recently, not possible on an individual level. Through the transmission of this digital performance language within an electronic music system, a musician can create and develop a song or composition in a practical, flexible and affordable production environment. In addition to composing and performing a song, the musician is also able to act as a techno-conductor, having complete control over the wide range of individual sounds that are created by various instruments, their *timbre* (sound and tonal quality), and *blend* (level, panning, and other real-time controls). MIDI may also be used to vary the performance/control parameters of both electronic instruments and effects devices during a performance.

The term *interface* refers to the actual data communications link and hardware that occurs in a connected MIDI network. MIDI makes it possible for all electronic instruments and devices to be addressed upon this network through the transmission of real-time performance and control-related messages. Furthermore, a number of instruments or individual sound generators within an

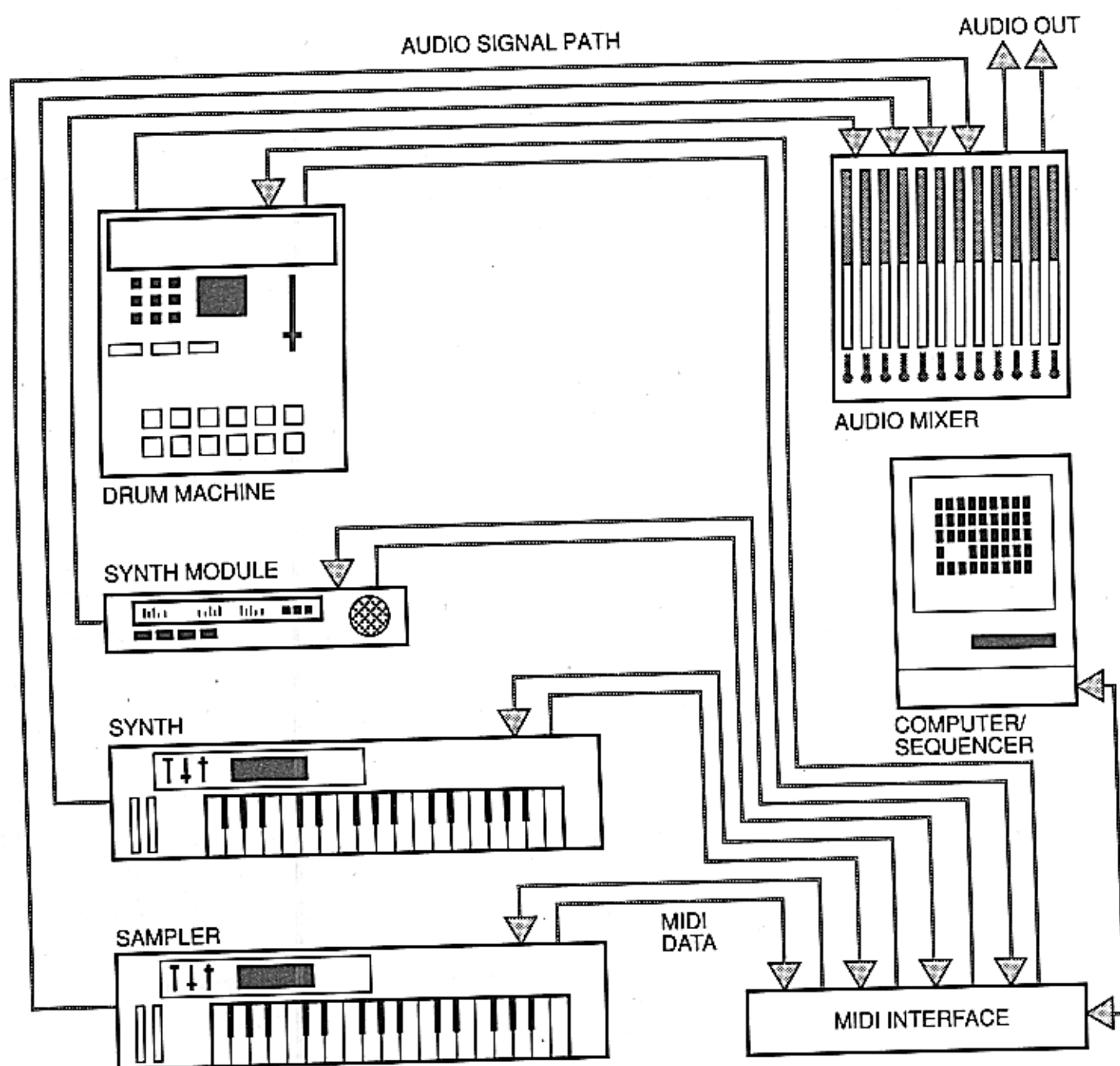


Fig. 1-1. Example of a typical MIDI system. (Courtesy of J. Rona Music)

instrument can be independently addressed upon a single MIDI line. This is possible as each MIDI data line is capable of transmitting performance and control messages over 16 discrete channels. This multichannel arrangement allows the performer to record, control, and reproduce MIDI data in a working environment that resembles the multitrack recording process which is familiar to most musicians. Once mastered, however, MIDI offers production challenges and possibilities that are beyond the capabilities of the traditional multitrack recording studio.

A Brief History

In the early days of electronic music, keyboard synthesizers were commonly *monophonic devices* (capable of sounding only one note at a time) and often generated a thin sound quality. These limiting factors caused early manufacturers to look for ways to link more than one instrument together to create a thicker, richer sound texture. This could be accomplished by establishing an instrument link that would allow one synthesizer (acting as a master controller) to be used to directly control the performance parameters of one or more synthesizers (known as *slave sound modules*). As a result, a basic control signal (known as *control voltage* or *CV*) was developed (Fig. 1-2).

This system was based upon the fact that when most early keyboards were played, they generated a DC voltage that was used to directly control voltage-controlled oscillators (which affected the pitch of a sounding note) and voltage-controlled amplifiers (which affected the note's volume and on/off nature). Since many keyboards of the day generated a DC signal that ascended at a rate of 1 volt per octave (breaking each musical octave into 1/12-volt intervals), it was possible to use this standard control voltage as a master-reference signal for transmitting pitch information to additional synthesizers. In addition to a control voltage, this standard required that a keyboard transmit a *gate signal*. This second signal was used to synchronize the beginning and duration times which are to be sounded by each note. With the appearance of more advanced *polyphonic synthesizers* (capable of generating multiple sounds at a time) and early digital devices on the market, it was clear that this standard would no longer be the answer to system-wide control, and new standards began to appear on the scene (creating incompatible control standards). With the arrival of early drum machines and sequencing devices, standardization became even more of a dilemma.

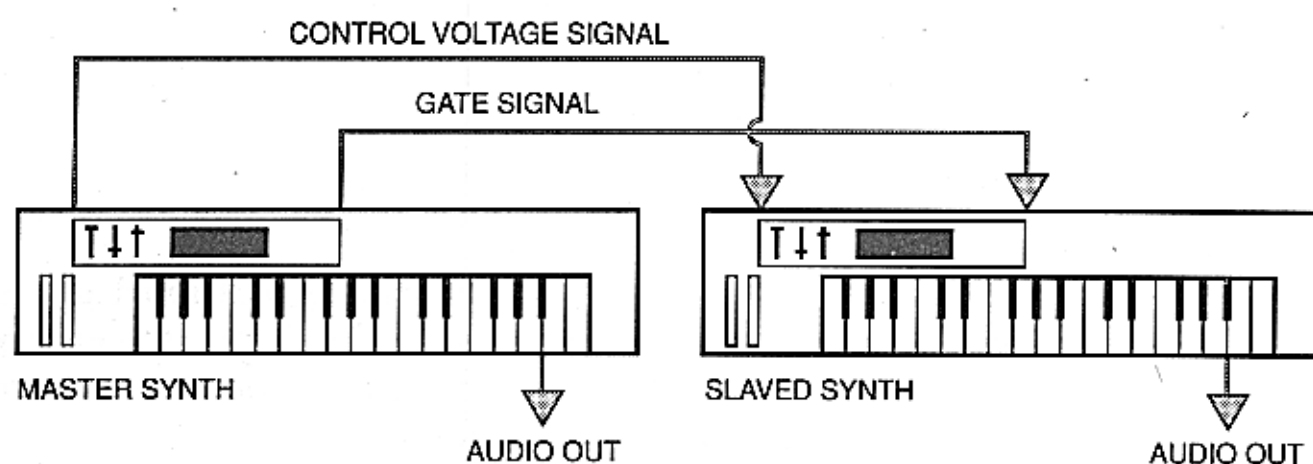


Fig. 1-2. Example of an instrument link using a control voltage and gate signal.

Synchronization between such early devices was often problematic, as manufacturers would often standardize upon different sync-pulse clock rates. These timing incompatibilities would result in a loss of sync over a very short time (when locking between devices from different manufacturers). This would render synchronization nearly impossible without additional sync-rate converters or other types of modifications.

As a result of these incompatibilities, Dave Smith and Chet Wood (then of *Sequential Circuits*, an early manufacturer of electronic instruments) began creating a digital electronic instrument protocol, which was named the *Universal Synthesizer Interface (USI)*. As a result of this protocol, it was possible for equipment from different manufacturers to directly communicate with one another. For example, the synthesizer from one company would work with another company's sequencer. In the fall of 1981, USI was proposed to the Audio Engineering Society. Over the course of the following two years, a panel (which included representatives from the major electronic instrument manufacturers) modified this standard and adopted it under the name of Musical Instrument Digital Interface (MIDI Specification 1.0).

The acceptance of MIDI was largely due to the strong need for a standardized protocol and advances in technology that allowed complex circuit chips and hardware design to be cost-effectively manufactured. It was also due, in part, to the introduction of Yamaha's DX-7 synthesizer in the winter of 1983, after which time keyboard sales began to grow at an astonishing rate.

With the adoption of this industry-wide standard, any device that incorporates a series of MIDI ports into its design is capable of transmitting and/or responding to the digital performance and control-related data that conforms to the MIDI specification. As the vast majority of electronic instruments and devices implement this communications language, the electronic musician is assured that the basic functions of any new device will integrate into an existing MIDI system.

Electronic Music Production

Today MIDI systems are being used by many professional and nonprofessional musicians alike. In turn, these systems are relied upon to perform an expanding number of production tasks, including music production, audio-for-video and film post-production, stage production, etc.

This industry acceptance can, in large part, be attributed to the cost-effectiveness, power, and general speed of MIDI production. Currently, a large variety of affordable MIDI instruments and devices are available on the market. Once purchased, there is often less need (if any at all) to hire outside musicians for a production project. In addition, MIDI's multichannel production environment enables a musician to compose, edit, and arrange a piece with a high degree

of flexibility, without the need for recording and overdubbing these sounds onto multitrack tape.

This affordability potential for future expansion and increased control capabilities over an integrated production system has spawned the growth of an industry, which is also very personal in nature. For the first time in music history, it is possible for an individual to realize a full-scale sound production in a cost- and time-effective manner. As MIDI is a real-time performance medium, it is also possible to fully audition and edit this production at every stage of its development—all within the comfort of your own home or personal production studio.

MIDI systems may also be designed in any number of personal configurations. They can be designed to best suit a production task (the production of a video sound track), to best suit the main instrument and playing style of an artist (percussion, guitar, keyboards), or to best suit a musician's personal working habits (choice of equipment and/or design layout). Each of these advantages are a definite tribute to the power and flexibility that is inherent within the capabilities that MIDI brings to modern music production.

MIDI in the Home

There is currently a wide range of electronic musical instruments, effects devices, computer systems, and other MIDI related devices that are available within the electronic music market. This range of diversity allows the electronic musician to select various devices which best suit his or her particular musical taste and production style. With the advent of the *large-scale integrated circuit chip (LSI)*, which enables complex circuitry to be quickly and easily mass-produced, many of the devices that make up an electronic music system are affordable by almost every musician or composer, whether they are a working professional, aspiring artist, or hobbyist. As most of these devices are digital or digitally controlled in nature, it can often be a simple and cost-effective matter to implement them with MIDI capabilities.

Due to the personal nature of MIDI, a production system can show up in a number of environments and can be configured to perform a wide range of applications. Basic and even many not-so-basic MIDI systems are currently being installed within the homes of a growing number of electronic musicians. These can range from systems which take up a corner of an artist's bedroom to larger systems that have been installed within a dedicated MIDI production studio.

Home MIDI production systems can be designed to functionally serve a wide range of applications, and they can be used by hobbyists and aspiring or professional musicians alike. Such systems also have the important advantage of allowing the artist to produce his or her music in a comfortable environment (whenever the creative mood hits). Such production luxuries, which would have cost an artist a fortune only a decade ago, are now within the reach of nearly every musician.



(A) J. Rona Music. (Courtesy of Jeff Rona and Home & Studio Recording Magazine)



(B) Walt Wagner Music Productions. (Courtesy of Walt Wagner)

Fig. 1-3. Examples of the MIDI production studio.

MIDI production systems often appear in a wide range of shapes and sizes and can be designed to match a wide range of production and budget needs. For example, a keyboard instrument (commonly known as a *MIDI workstation*), will often integrate a keyboard, polyphonic synthesizer, percussion sounds, and a built-in sequencer into a single package. This is essentially an all-in-one system that allows a musician to cost-effectively break into MIDI style production. Additional MIDI instruments can easily be added to this workstation by simply plugging its MIDI out port to the MIDI in port of the new device (or devices), plug the extra audio channels into your mixer, and you're in business.

Other MIDI systems, made up of discrete MIDI instruments and devices, are often carefully selected by the artist to generate a specific sound or to serve a specific function within the system. Although this type of MIDI system is often not very portable, it is commonly more powerful, as each component is designed to perform a wider range of task-specific functions. Such a system might include one or more keyboard synthesizers, synth modules, samplers, drum machines, a computer (with sequencer and other forms of MIDI software), effects devices, and audio mixing capabilities.

MIDI in the Studio

MIDI has also dramatically changed the sound, technology, and production habits within the professional recording studio. Before the onset of MIDI, the recording studio was one of the only production environments that would allow an artist or composer to combine various instruments, styles, and timbres into a final recorded product. The process of recording a group in a live setting, often was (and is) an expensive and time consuming undertaking. This is due to the high cost of hiring session musicians and the high hourly rates charged for the use of a professional music studio. In addition, a number of hours are usually spent capturing the "ideal performance" on tape.

With the advent of MIDI, a large part of modern music production can be performed and, to a large extent, produced before going into the recording studio. This capability has reduced the number of hours required for laying tracks on a multitrack tape to a cost-effective minimum. For example, it is now commonplace for groups to preproduce an entire album project by using their own personal MIDI system. Once completed (or nearly completed), the group can bring the MIDI system into the studio and lay the isolated audio channels down to a multitrack recorder. Once all of the MIDI tracks have been transferred to tape, the process of recording vocals, live sources, or flying in vocal samples to tape can begin. Afterwards, the completed master tape can be mixed down into a final musical product. Alternatively, the MIDI tracks may not be recorded onto multitrack tape at all, but may be synchronized to tape, allowing the sequencer to act as an extension of the recorded tracks.

MIDI within Audio-For-Video and Film

Electronic music has also become a major tool within the scoring and audio postproduction phases for the professional video and film media. Standard MIDI production practices have enabled music composers and effects artists for the visual media to become increasingly productive. As a result, MIDI has come to be recognized as a powerful, cost-effective tool in the production of TV commercials, industrial videos, TV, and full-feature motion picture sound tracks.

Although many electronic music composers for the visual media work independently, many have teamed up with recording studios, video production houses, and audio-visual firms to combine forces in creating a full in-house visual and music production team.

MIDI in Live Performance

Electronic music production and MIDI are also firmly established within the stage setting of live performance. In addition to the sound quality produced by many modern electronic keyboard systems, MIDI's onstage popularity is primarily due to two factors: preproduction programming and the ability to easily control a number of devices from a central location.

The ability to sequence a number of rhythm and background parts in advance, chain them together into a single, controllable sequence (using a jukebox-type sequencing program), and play back this sequence onstage has become a strong live-performance tool for many musicians. This technique is currently in use by solo artists who have become one-man-bands by adding background sequences (often consisting of a drum machine and a host of other possible instruments) to their live vocals and playing. Larger techno-pop groups commonly make use of extensive onstage sequencing for driving a wide range of instruments and effects in addition to their live playing.

Many live performers make use of the real-time control capabilities of MIDI in an onstage environment. This includes the ability of a number of slaved devices to be played from a single keyboard, percussion pad, or other type of controller. MIDI also allows different musical and percussion parts to be played from a single controller. In addition to communicating performance-related data, MIDI is capable of controlling a number of device parameters in real time. For example, a central MIDI controller (such as a keyboard controller or MIDI footswitch controller) can be used to change the sound patches and performance parameters (such as volume, panning, etc.) of various MIDI instruments or effects devices.

MIDI is also indirectly involved in the creation of many live performances. Through the use of a music notation program and production system, MIDI can often help a composer input, edit, and audition a musical score. Once finalized, a sequenced computer score or series of lead sheets can be printed out as hard copy for distribution to the live players onstage or in the studio.

Summary

From these applications, it can be seen that Musical Instrument Digital Interface (MIDI) has become widely accepted by consumers and professionals in many facets of the music industry. It has also brought about sweeping changes in the way that many styles of music are produced, making it possible for the individual artist to create his or her music in an affordable and practical manner. MIDI has accomplished this with an amazing degree of success by effectively integrating the electronic music production system. Through the use of MIDI, it is possible for any controlling source (such as a keyboard, drum pads, etc) to directly communicate with another instrument within the system. Using such an arrangement, it is a simple matter to slave more than one instrument to a single controller (thereby creating a richer, more complex sound texture, and reducing the need for additional redundant keyboards).

Through the digital communications language of MIDI it is also possible for electronic musical instruments and devices to directly communicate with a personal computer. This allows the artist to utilize the processing power of the personal computer for performing a wide range of recording, editing, librarian, and control tasks via MIDI.